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ABSTRACT

Are early retiree health benefits (RHBs) a form of deferred compensation that binds workers to an employer? Most employers who offer RHBs offer them only to workers who have 10 or more years of tenure with the firm and have reached age 55. Accordingly, workers in firms offering RHBs have an incentive to stay with a firm in the years before they attain eligibility for RHBs, and a greater incentive than otherwise to retire thereafter. We test for the existence of such a pattern of incentives by examining the age-specific relationship between workers' eligibility for RHBs and retirement. The findings suggest that workers in RHB-offering firms are *less* likely to retire at ages 50 and 51 than similar workers in firms that do not offer RHBs. Also, RHB-eligible workers aged 60 and 61 are *more* likely to retire than similar RHB-ineligible workers. Such a pattern is consistent with RHBs acting as part of a delayed-payment contract of the kind described by Lazear (1979, 1981).

JEL Classification Codes*:* H25; I18; J26; J32; M52

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1. Introduction

Retiree health benefits (RHBs) are of two kinds: those offered by employers to early retirees (former employees under age 65 who are not yet eligible for Medicare) and those offered to retirees aged 65 and older as a supplement to Medicare. Early RHBs—the first kind—have given rise to a range of policy issues and related research, including their influence on access to health care (Fronstin 2005), how they are to be funded, especially in the public sector (McNichol 2008), and their influence on retirement (see below).

In this paper, we investigate a set of related questions on RHBs that, to our knowledge, have not been addressed in the economic literature: Why do employers offer early RHBs? In particular, are early RHBs part of a compensation package that employers offer in order to attract and retain workers who are willing to make a long-term commitment to the firm? And does empirical evidence on the retirement patterns of RHB-offered workers tend to support or reject this "agency" theory of RHBs? Understanding why employers offer early RHBs is important because RHBs influence access to health care and retirement, and in addition because understanding employers' motives for offering early RHBs can yield insights into the influence of workplace incentives on workers' effort and labor supply behavior (Huck, Seltzer, and Wallace 2011).

Our analysis proceeds in the following steps. Section 2 begins with institutional background on RHBs, a description of Edward Lazear's (1979, 1981, 1983) theory of delayed payment contracts, and a discussion how that theory applies to firms' RHB offers. Following a brief review of the existing literature on RHBs and retirement (section 3), we describe our approach to estimation (section 4). The basic model we specify is similar to other reduced-form models in the RHB-retirement literature, but in addition to a restricted model in which the

relationship between RHB offers and the probability of retirement is invariant to age and other individual characteristics, we specify a less restrictive model in which the estimated relationship between RHBs and retirement varies with workers' demographic characteristics. 5 describes the data we use and details the variables used to specify the models.

The empirical findings are described in section 6. Estimates from the restricted model are similar to previous findings in the literature and suggest that any worker with an RHB offer is about 3 percentage points (11 percent) more likely to retire than a worker without. But statistical tests reject the restricted model in favor of the unrestricted model, which suggests that workers aged 50–51 in RHB-offering firms are *less* likely to retire than similar workers in firms that do not offer RHBs. In contrast, workers aged 60–61 with RHB offers are *more* likely to retire than similar workers without RHB offers. This pattern is consistent with the hypothesis that RHBs comprise part of a delayed-payment contract. It also suggests the importance of freeing up the functional form of the model so that the relationship between RHBs and retirement is allowed to differ by age.

Section 7 illustrates the implications of the findings by simulating survivor functions of cohorts of workers offered (and not offered) RHBs. Simulations based on the preferred unrestricted specification suggest that, compared with a cohort of workers not offered RHBs, a cohort of RHB-offered workers contributes more person-years of employment before age 57, and fewer person-years of employment after age 57.

2. Retiree Health Benefits as Part of a Delayed-Payment Contract

Early RHBs are a nonwage benefit voluntarily provided by some employers to their employees. When available, they are offered to an employee who retires before age 65 (the age

of eligibility for Medicare) if that employee meets specified age and years-of-service (job tenure) requirements. As Table 1 shows, the age and service requirements in a sample of large employers vary substantially among employers and have changed over time. However, in 2003, more than 60 percent of the employers who offered early RHBs required an employee to be at least age 50 and to have at least 5 years of service with the firm. Many other RHB-offering employers (35 percent in 1996, and 18 percent in 2003) had more than one set of eligibility criteria—for example, an employer might offer early RHBs to any worker with 25 years of service (regardless of age), or to a worker aged 62 or older conditional on a minimum of 15 years of service. Accordingly, RHBs are a benefit offered to employees only after they have reached some minimum age and after they have accumulated some minimum years of service with the employer.

Why would an employer offer such a benefit to employees? The generally accepted list of reasons for offering employee benefits includes favorable tax treatment of nonwage benefits under the corporation and personal income tax codes (Rice 1966); scale economies in the provision of benefits (Lester 1967); a belief by employers that consumption of certain goods will enhance production, which manifests itself as paternalistic provision of certain benefits such as health insurance (Rosen 2000); and the need of some firms to create a long-term bond between the worker and the firm (Lazear 1979).

The third of these reasons—paternalism or "productive consumption"—cannot explain the provision of RHBs because, unlike regular employer-provided health insurance (EPHI), RHBs are received *after* a worker has retired from the firm. RHBs are subject to favorable tax treatment and scale economies, so these are both potentially valid explanations for RHBs. But RHBs have no special advantage over other employee benefits in either regard.

The last motive—the need to establish a worker-firm commitment or long-term bond—is also a potentially valid explanation for the existence of RHBs because in most cases a worker must have been with a firm for at least 5 years and have reached at least age 50 to be eligible for early RHBs. This delayed payment feature of RHBs distinguishes them from most other employee benefits. For example, the most widespread employee benefits—employer-provided health insurance and defined-contribution pension plans—are provided after (at most) a short time with the firm.

In a series of seminar papers, Edward Lazear (1979, 1981, 1983) proposed an agency theory of delayed payment contracts. According to the theory, when firms find it difficult to monitor the effort and honesty of employees, they must develop a compensation scheme that discourages shirking and malfeasance. One such scheme is a delayed payment contract—a long-term contract that shifts compensation to the end of a worker's tenure with the firm. Employees who work hard and are honest earn the reward of high compensation late in their careers. Those who shirk or behave badly suffer the consequences of termination. Hence, by deferring compensation, the firm creates an incentive for employees to work hard and honestly.

Figure 1 illustrates Lazear's argument and alternative ways of implementing a delayed payment contract. $V(t)$ is the worker's value of marginal product (VMP) if he or she is paid a wage equal to VMP in each period. But to reduce shirking and malfeasance, the employer offers a contract such as $W^*(t)$, which pays less than the worker's VMP early in the career (before t^*), and more than the worker's VMP later. Because this rising wage profile creates an incentive to work hard, the worker's VMP in each period is $V^*(t)$—higher than otherwise. Honest, productive workers will choose firms offering such a contract.

Lazear (1979, 1981) emphasizes three points about this delayed payment contract. First, T is the age at which retirement would optimally occur for this worker because at T, the reservation wage [shown by the rising $R(t)$ function] equals the worker's VMP [that is, $R(T) = V^*(T)$]. Second, T is the age at which the present value of the "loans" made by the worker to the firm before t^* equals the present value of the repayments made by the firm to the worker after t^*. A worker who leaves the firm or is terminated before T will have contributed more to the firm than he or she receives in compensation, creating an incentive to be a solid employee so as to continue with the firm. Third, under the delayed payment contract, the wage paid at T exceeds the worker's reservation wage [that is, $W^*(T) > R(T)$], so the worker will not retire voluntarily at the optimal date. But T is implicitly the end of the delayed payment contract because at T, the firm has fully repaid the worker. Continuing to pay $W^*(t)$ would mean paying economic rents to the worker.

If it could, the firm would mandate retirement at T. But mandatory retirement has been barred for most workers in the United States since 1986 under amendments to the Age Discrimination and Employment Act, so employers must fashion others ways of inducing workers to retire at the end of the delayed payment contract.[1] One possibility is to offer a pension plan that an optimizing worker would choose to accept at T. Under a typical defined-benefit (DB) pension plan, a worker accepts a somewhat lower wage in exchange for the promise of a pension benefit that is determined by a formula (for example, years of service times some percentage of the average wage during the last three to five years of work). It is well-known that the present value of these plans rises to a maximum, usually around age 62, then drops as any increment to the annual benefit amount is outweighed by the shorter expected retirement

[1] The ADEA barred mandatory retirement before age 70 in 1978, then barred it completely in 1986 for all but bona fide executives and a few occupations such as firefighters, law enforcement officers, and air traffic controllers (Feder 2010).

duration implied by continuing to work for another year (Burkhauser and Quinn 1983a,b; Friedberg and Webb 2005).

Figure 1 shows the effective wage profile for a worker with a typical DB pension plan as $W_p(t)$, which lies below $W^*(t)$ (to reflect lower wage compensation during the working years in order to fund the pension) and falls after reaching a maximum at T (to reflect the loss of pension wealth from working beyond T). Further, the worker's reservation wage can be expected to be discontinuous at T if the worker becomes eligible to receive pension benefits at that time—this is shown by $R_p(t)$ in Figure 1. The combination of a falling effective wage [$W_p(t)$] and a discrete jump in the reservation wage [$R_p(t)$] leads the worker to retire at T—the optimal outcome and the outcome desired by the firm.

Eligibility for early RHBs at T would enhance the jump in $R_p(t)$ and further increase the incentive to retire. Accordingly, RHBs would seem to be a natural component of a delayed payment contract that ends earlier than age 65. They are uniquely adapted to the U.S. labor market, in which public health insurance benefits have not been available until age 65 (except for the poor and near-poor). For U.S. workers not covered by a spouse's employer-provided health insurance, RHBs may be necessary to induce many workers to act on the retirement incentives in a DB pension plan and retire before age 65. In Lazear's framework, RHBs are like DB pensions in that they are the manifestation of a long-term delayed payment contract.[2]

Lazear's theory implies that workers employed by firms offering delayed payment contracts will retire at or about age T. This suggests two testable implications with respect to RHBs and retirement. First, we should observe relatively *low* retirement probabilities for workers in RHB-offering firms in the years preceding RHB eligibility. The reason, of course, is that

[2] As DB pension plans have become more regulated in the last 30 years, employers have replaced them with defined contribution (DC) pension plans (Wolff 2011). Because DC plans do not create a financial incentive to retire at a particular age, this development has likely increased the importance of early RHBs as a retirement incentive.

retiring before eligibility would mean giving up RHBs—the reward for hard work and honesty.[3] Second, we should observe relatively *high* retirement probabilities for workers in RHB-offering firms once they become RHB-eligible. Our goal is to test these two hypotheses.

3. RHBs and Retirement: Previous Research

Economists' interest in early RHBs has focused mainly on the incentives they create to retire before age 65: workers with RHBs can retire before age 65 and retain their former employment-related health insurance at relatively low cost, whereas workers without RHBs who retire before age 65 must either pay for their former employer's health benefits at cost or purchase private health insurance. Early estimates of the influence of RHB eligibility on retirement used data from the Retirement History Survey, conducted mainly during the 1970s (Gustman and Steinmeier 1994, Rust and Phelan 1997), the Survey of Income and Program Participation (Karoly and Rogowski 1994, Madrian 1994), the Current Population Survey (Gruber and Madrian 1995), and the National Medical Expenditure Survey (Madrian 1994). With the notable exception of Gustman and Steinmeier (1994), these studies concluded that RHB availability (or "continuation coverage" in the case of Gruber and Madrian) significantly increases the probability that an older worker will retire.

Hurd and McGarry (1993), Rogowski and Karoly (2000), Blau and Gilleskie (2001, 2008), and Congdon-Hohman (2008) all estimate the influence of RHBs on retirement (or retirement expectations in the case of Hurd and McGarry) using data from the Health and Retirement Study (HRS), which we use below. Hurd and McGarry (1993) examine wave 1 (1992) of the HRS and find that workers eligible for RHBs partly or fully paid by the employer

[3] Using pension offers, a similar implication has been tested by Allen, Clark, and McDermed (1993), who find that turnover is substantially lower in firms offering pensions than in firms that do not.

are significantly less likely than other workers to report that they expect to work past age 62. Rogowski and Karoly (2000) and Blau and Gilleskie (2001) each take advantage of two waves of the HRS and find that workers with an offer of RHBs are significantly more likely to retire than workers without. In particular, Rogowski and Karoly (2000) find that workers with RHBs in 1992 were about 11 percentage points more likely to be retired in 1996 than those without. Blau and Gilleskie (2001) emphasize the importance of cost-sharing on the estimated relationship between RHBs and retirement. They examine retirement transitions during 1992–1994 and find that RHBs increased the probability of retirement by 6 percentage points if the employer paid the full RHB premium, but only by 2 percentage points if retirees had to contribute to the RHB's cost. Johnson, Davidoff, and Perese (2003) also highlight the importance of RHB premium costs to the retirement decision, and Congdon-Hohman (2008) focuses on the health insurance of wives as a factor in husbands' retirement decisions.

Two papers (Marton and Woodbury 2010; Nyce et al. 2011) examine the influence of RHBs on retirement at particular ages, and both find that the relationship between RHBs and retirement is strongest for workers in their early 60s. Finally, Blau and Gilleskie (2008) estimate a dynamic structural model of retirement using the first four waves of the HRS (1992–1998, or three transitions). They find relatively small effects of RHBs on transitions out of employment: The exit rate from employment increases from 0.053 to 0.060 (0.7 percentage points, or less than 12 percent) for men who gain RHB offers, and decreases from 0.091 to 0.069 (2.2 percentage points, or 24 percent) for men who lose them.

Concerns about the endogeneity of RHBs have been raised frequently in this literature—see especially Blau and Gilleskie (2008). If workers who want to retire early seek out firms that provide RHBs, an observed relationship between RHBs and retirement will reflect worker

heterogeneity rather than a causal effect of RHBs. For the questions we are investigating, the main point of interest is the partial correlation between the promise (or offer) of RHBs and the probability of retirement at each age, rather than the causal effect of RHBs on retirement. In the Lazear model, firms provide RHBs because they want to attract workers who are willing to make a long-term commitment to the firm and who know that malfeasance will lead to the loss of a desired benefit. If firms have this agency motive for offering RHBs, workers with RHB offers will inevitably differ in unobserved characteristics from workers without RHB offers. We should expect workers with RHB promises to have lower retirement probabilities at ages preceding the age of RHB eligibility, and higher retirement probabilities once they are eligible for RHBs.

4. Approach to Estimation

The HRS data we examine have information on six discrete two-year time intervals (seven interviews, each separated by about two years) starting in 1992, so a discrete-time hazard model of retirement is a natural approach to estimation. Specifically, we model the probability of worker i being retired at time t+1 (conditional on having been employed at time t) as a function of observables and unobservables at time t:

$$\Pr(retired_{i,t+1} = 1 \mid \bullet) = F[\mathbf{x}_{it}\boldsymbol{\beta} + \eta_t + c_i] \tag{1}$$

where $\mathbf{x}_{it}$ is a vector of person-specific characteristics capturing the observed heterogeneity in the sample (these may be either time-varying or time-constant), η_t denotes transition-specific fixed effects (to account for economic and labor market conditions), and c_i denotes unobserved worker-specific effects. We specify $\mathbf{x}_{it}\boldsymbol{\beta}$ as follows:

$$\mathbf{x}_{it}\boldsymbol{\beta} = \beta_1(rhb_{it}) + \beta_2(pension_{it}) + \beta_3(wealth_{it}) + \beta_4(age_{it}) + \beta_5(demog_{it}) + \beta_6(health_{it}) + \beta_7(spouse_{it}) + \beta_8(jobchar_{it}) \tag{2}$$

where rhb_{it} denotes a set of indicators modeling whether worker i had employer-provided health insurance (EPHI) and an RHB offer in year t, $pension_{it}$ and $wealth_{it}$ are sets of indicators of the pension and nonpension wealth of worker i in year t, age_{it} is a set of age indicators, $demog_{it}$ denotes variables indicating race and level of education, $health_{it}$ is a set of health indicators, $spouse_{it}$ is a set of dummies indicating whether worker i was married in year t and whether his spouse was working, and $jobchar_{it}$ is a set of job characteristic indicators. The rationale for including these variables in models of retirement behavior is well established in the literature—see for example Ruhm (1990a) and Quinn, Burkhauser, and Myers (1990)—although different retirement models specify these variables in different ways. In particular, the specification of pension wealth in models of retirement has been an active field of research during the past 25 years—see Coile and Gruber (2007), Friedberg and Webb (2005), and Gustman and Steinmeier (2001/2002) for insightful guides. We return to these points below.

Equation (2) follows the existing literature in restricting the relationship between an RHB offer and retirement to be the same for all workers—that is, β_1 is a "main effect" that does not vary over workers. This assumption is clearly unappealing in light of the central hypothesis we are testing—that the relationship between RHBs and retirement varies with age. We also want to ensure that an estimated relationship between RHB offers and age is not picking up some alternative characteristic-specific influence of RHBs, so it makes sense to specify the model flexibly and allow the relationship between RHBs and retirement to vary with age, other observables, and over time. Accordingly, we respecify equation (2) by fully interacting rhb_{it} with other explanatory variables and η_t (the transition indicators):

$$\mathbf{x}_{it}\beta = \beta_1(rhb_{it}) + \beta_2(pension_{it})(rhb_{it}) + \beta_3(wealth_{it})(rhb_{it}) + \beta_4(age_{it})(rhb_{it})$$
$$+ \beta_5(demog_{it})(rhb_{it}) + \beta_6(health_{it})(rhb_{it}) + \beta_7(spouse_{it})(rhb_{it}) + \beta_8(jobchar_{it})(rhb_{it})$$

$$+ \eta_t (rhb_{it}) \qquad (3)$$

In equation (3), $(age_{it})(rhb_{it})$ denotes age indicators by themselves *and* age indicators fully interacted with the health insurance-RHB indicators (with β_4 the vector of coefficients on these indicators), and similarly for the other terms in the equation. Retrieving subgroup estimates from this fully interacted model is straightforward: After substituting equation (3) into equation (1), we differentiate with respect to *rhb* and evaluate the derivative for a given subgroup at the sample mean (that is, substituting sample mean characteristics for variables other than those in the given subgroup).

A convenient choice for the function F in equation (1) is the standard normal cumulative density, which allows estimation of the model as a pooled probit. Equation (1) is an unobserved-effects model for panel data, so if the individual fixed effects c_i are correlated with the observable characteristics $\mathbf{x}_{it}$, the estimates of $\boldsymbol{\beta}$ (β_1 in particular) cannot be interpreted as causal effects of x on the conditional probability of retirement (because individual fixed effects are omitted). However, because the Lazear model presumes the existence of unobserved heterogeneity (indeed, incentives like RHB offers would be unnecessary if firms could observe all relevant worker characteristics), this does not prevent testing Lazear's agency hypothesis. Also note that pooled probit combines the individual fixed effects c_i and the idiosyncratic error u_{it} into a single composite error, v_{it}, which will be serially correlated. This latter issue can be resolved by imposing structure on v_{it} and applying a random effects estimator, which is the procedure we use.

5. Data and Variable Specification

We estimate equation (1) using a sample of men born between 1931 and 1941 from the HRS.[4] The analysis below is restricted to men who were working full-time (≥ 35 hours per week) at the time of the first survey in 1992. Available HRS data allow us to follow these men through six transitions: 1992–1994, 1994–1996, 1996–1998, 1998–2000, 2000–2002, and 2002–2004.

Figure 2 summarizes the behavior of the men in the main HRS sample over the 12 years we observe them. The sample starts in 1992 with 3,150 men aged 51–61 who were employed full-time. Between 1992 and 1994, 303 left the study due to attrition (death or other reason), so we consider 2,847 men to have been "at risk" of retirement during the 1994–1996 transition. Of these, 225 (8 percent) reported themselves as "retired" in the 1994 interview, and another 309 reported themselves in one of five "other" labor force statuses—part-time work, unemployment, partial retirement, disability, or not in the labor force (the "other" category in Figure 2).[5] Of the 2,313 employed full-time men still in the sample in 1994, 181 men left the sample through attrition by 1996, so 2,132 men remained "at risk" of retirement. Of these, 226 (11 percent) reported they had retired by 1996, and 235 reported moving to the "other" category. The remainder of the figure follows in the same way between each two-year time period. Ultimately, of the 3,150 men, 1,060 reported they had retired by 2004, 766 were lost to the study due to attrition, 997 reported moving to the "other" category, and 327 continued full-time employment during the entire 12 years. Note that we treat departure from full-time employment as an absorbing state—once a worker leaves full-time employment, he is lost to further full-time work and another "retirement event." As Ruhm (1990b, 1995) and Maestas (2010) have shown, this is

[4] See Institute for Social Research (n.d.). For the empirical analysis, we started with the RAND HRS Data file, Version F, which is a simplified longitudinal data set based on the HRS data (St. Clair et al. 2006).
[5] Note that these "other" workers did not report themselves as retired.

not entirely realistic, but it is a simplification that makes sense if the model describing the original decision to retire differs from that describing subsequent retirement decisions.

Figure 2 suggests two alternative ways of defining retirement—one "narrow" and one "broad." The narrow definition classifies an individual as retired only if he reports himself as such; the broad definition classifies him as retired if he reports himself as retired or occupies one of the "other" categories (all of which imply that he is no longer employed full-time). In a highly useful discussion of how to define retirement in the HRS, Gustman and Steinmeier (2001/2002) refer to the narrow measure as "subjective" (because it is based solely on a self-assessment) and to the broad measure as a "hybrid" (because it combines a self-assessment with reported labor force status). Gustman and Steinmeier's analysis suggests that hybrid measures of retirement (like the broad measure) ameliorate deficiencies of using either self-reports or measures of labor force status alone. For our purposes especially, the broad measure makes sense because we want to know when a worker leaves a "career" job, an event that would trigger RHB receipt. In the empirical work below, we report estimates based on both the narrow and broad definitions, but we emphasize estimates based on the latter.

The HRS survey allows us to specify $\mathbf{x}_{it}$ using a rich set of explanatory variables, displayed in Table 2. The first column of Table 2 shows sample percentages for each variable, calculated from the 9,657 two-year transitions observed in the HRS sample of 3,150 men who were working full-time in 1992. The second column shows sample percentages calculated from the 1992 (wave 1) observations of these 3,150 men. The third column shows sample percentages calculated from the 1992 observations of the 2,057 men who retired (broad definition) during one of the six transitions we analyze.

We model whether worker *i*'s employer offered RHBs in year *t* (rhb_{it}) using a set of mutually exclusive dummy variables for the following four states: [6]

- the worker had EPHI but *no offer of RHBs* (the reference category)
- the worker had EPHI and *either worked for an employer who offered RHBs or would receive health benefits if he retired* (see the discussion below)
- the worker had no EPHI but was *covered by some other type of health insurance*
- the worker had *no health insurance* coverage

Fronstin (2005, Figure 16) found that 57 percent of men aged 45–64 reported being eligible for early RHBs in 1996.[7] As shown in Table 2, a similar percentage of men (56 percent) had employers who offered RHBs in wave 1 (1992) of the HRS sample we analyze. However, the RHB questions in the first two waves (1992 and 1994) of the HRS differ from those in later waves. In waves 1 and 2, the HRS survey asked whether the EPHI that currently covers a worker is "available to people who retire" and whether the employer has "any health insurance plan available to retirees." These questions are well suited to detecting the presence of a delayed payment contract because they do not ask whether a worker's EPHI would cover him if he retired now, but rather indicate whether the employer offers RHBs. In the 1996 wave and later (1998, 2000, 2002, and 2004) the survey asks two questions, both pertaining to whether a worker could continue his current EPHI "up to the age of 65."[8] These questions are more specific to the worker's current eligibility for RHBs.[9]

[6] Missing values for the RHB variable have been a concern associated with using the HRS; however, once we impose our sample restrictions to focus on men who were working full-time at the time of the first survey in 1992, we have a yes or no response for the RHB variable for all observations.
[7] Fronstin's estimate is based on the 1997 Survey of Income and Program Participation.
[8] The first question is, "Can you continue [EPHI] for yourself up to the age of 65?" The second is, "If you left your current employer now, could you continue [EPHI] coverage for yourself up to the age of 65?"
[9] The RAND documentation points out that the 1996 and later questions could be interpreted in various ways. For example, a respondent could answer "yes" at age 63 1/2, thinking that he or she could continue his EPHI through age 65 under the Consolidated Omnibus Budget Reconciliation Act, even though there would be no employer

To address concerns about the RHB questions and the change that occurred after the 1994 wave, we estimated the models separately for the first two transitions (1992–1994 and 1994–1996) and again for the last four transitions (1996–1998, 1998–2000, 2000–2002, and 2002–2004). Surprisingly, perhaps, the two sets of estimates (not reported) are quite similar. We would speculate that two factors—the aging of the sample and interacting the RHB variable with age—minimize the effect of the change in the RHB questions and the way they might be interpreted. It also seems possible that, although the RHB questions changed in wave 3, respondents continued to interpret them to have their original meaning from waves 1 and 2.

The model includes two sets of indicators modeling the type and amount of pension wealth held by worker *i* in year *t* ($pension_{it}$). The first models the asset value of any defined benefit (DB) pension the worker expected to receive using four indicators:[10]

- not included in a DB plan, hence no DB pension wealth (the reference category)
- positive DB pension wealth up to $100,000
- DB pension wealth of $100,000 to $200,000
- DB pension wealth greater than $200,000

Table 2 shows that just over two-fifths of the sample (42 percent) had positive DB pension wealth in 1992 (wave 1).[11]

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contribution. Alternatively, the respondent could respond "yes" to the first question, thinking he or she will continue to be employed, and so will continue to be covered (even if the employer did not offer retiree health benefits).

[10] Specifically, the HRS collected employer contact information in 1992 and 1998, then obtained information on DB pension plans directly from employers when possible (Health and Retirement Study 2006, pp. 3–5). From these data, the HRS calculated or imputed several values of each worker's DB pension plan for 1992 and 1998. We use "DB value at expected retirement age prorated and discounted" to 1992 or 1998, which approximates the present value of expected future plan benefits, based on the worker's work to date and self-reported expected retirement age. The amount is intended to be comparable to a defined contribution (DC) pension accumulation, which is why we use it.

[11] This specification of DB pension incentives for retirement is similar to that used in early research on pensions and retirement (see the review by Quinn, Burkhauser, and Myers 1990). Important papers by Lazear and Moore (1988) and Stock and Wise (1990) noted that optimal retirement decisions require workers to be forward-looking and consider the "option value" of continued work, and empirical work has implemented this idea in various ways (Samwick 1998, Gustman and Steinmeier 2001/2002, Friedberg and Webb 2005, Coile and Gruber 2007). Using DB pension wealth levels, rather than a more complicated construct, could represent a misspecification that could lead to

A second set of pension wealth indicators model the current accumulation (if any) in defined contribution (DC) pension accounts held by the worker: not included in any DC plan (the reference category); positive DC accumulation up to $100,000; DC accumulation of $100,000 to $200,000; and DC accumulation greater than $200,000. Table 2 shows that, in the first year they were surveyed, just over one-third of the sample had a DC plan; however, only 5.6 percent had DC accumulations greater than $100,000.[12]

We also include two sets of conventional wealth indicators (Farnham and Sevak 2007). The first captures worker *i*'s housing wealth at each interview, defined as the net value of the primary residence.[13] The second set of wealth indicators gives the value of worker *i*'s non-housing wealth at each interview, defined as the sum of financial wealth (stocks, checking accounts, CDs, bonds, and other financial assets) plus the value of real estate other than primary and secondary residences, vehicles, and businesses.[14] For both housing and non-housing wealth, we construct sets of dummy variables with the same categories as those used for DB and DC pension wealth. Table 2 shows that in the first year they were interviewed, 62 percent of the sample had positive housing wealth up to $100,000, and 62 percent had positive non-housing wealth up to $100,000.

The demographic controls included in the model ($demog_{it}$) are age in year *t* (an indicator for each age from 50 to 64, and an indicator for 65 and older), an indicator equal to 1 for

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overstatement of size of the relationship between RHBs and retirement. For example, many DB pension plans create incentives for a worker to retire shortly after reaching the plan's early retirement age or at plan's normal retirement age (Kotlikoff and Wise 1989, Samwick 1998). However, Lazear's theory of delayed payment contracts leads to the expectation that retirement incentives from a DB pension plan and the timing of eligibility for RHBs are correlated by design, in which case DB pension incentives and RHB eligibility would be collinear.

[12] DC pension accumulations were reported by workers in every wave, unlike information on DB pensions, so they can vary fully over time.

[13] The net value of any secondary residence is available only starting in 1998. Accordingly, the estimates leave out any consideration of the value of a secondary residence.

[14] Note that this variable includes IRAs and Keoghs, which are nominally forms of retirement wealth; however, because many households draw on these assets before retirement (even though they suffer a tax penalty), treating them as nonretirement wealth is reasonable.

nonwhites, and four schooling indicators (less than high school, high school graduate only, some college, and college graduate or more).[15]

To capture worker *i*'s health status in year *t* ($health_{it}$), we include three sets of indicators. The first models the worker's body mass index (BMI, weight in kilograms divided by height in meters squared) in year *t*: BMI < 18.5 (underweight); 18.5 ≤ BMI < 25 (normal weight); 25 ≤ BMI < 30 (overweight); and BMI ≥ 30 (obese). Table 2 shows that 70 percent of the workers in the sample were overweight or obese by this measure in the first year of the HRS. The second is a dummy equal to 1 for workers who report having two or more chronic health conditions in year *t*—high blood pressure, diabetes, cancer, chronic lung disease, heart disease, stroke, or arthritis. This is only a rough indicator of a respondent's health, in part because it does not distinguish between more and less serious conditions. Accordingly, we also include a dummy variable equal to 1 for respondents who report being in fair or poor health in year *t*.

Because the labor force status of a spouse is likely to be important to an individual's decision to retire, we include a set of mutually exclusive dummies capturing the marital status of each man and the employment status of his wife in year *t*: not married (the reference category), married to a woman working full-time, married to a woman working part-time, and married to a woman who did not work (unemployed, retired, disabled, or not in the labor force). Couples' labor supply decisions are likely to be made jointly, and the above set of indicators may be endogenous, although few papers on health insurance and labor supply have addressed the issue (but see Blau and Gilleskie 2006, Kapur and Rogowski 2007, and Congdon-Hohman 2008). We have checked the sensitivity of the main estimates to inclusion or exclusion of these variables and find that the results are essentially unchanged.

[15] Brown (2006) has found that workers tend to retire at the age they regard as "usual" for workers of their type; however, we have not taken advantage of the "usual retirement age" question that is asked of RHS respondents.

Finally, we include indicators of two aspects of each worker's job in year *t*: whether he is in a blue-collar occupation and whether he is self-employed. Blue-collar work tends to be physically taxing, and we expect it to be related to earlier retirement. Self-employed workers tend to have a taste for work, and we expect them to be less likely than others to retire. Also, as shown in Table 1, RHBs are generally available only to workers with substantial job tenure, so we also include a set of job tenure indicators.

Comparison of columns 2 and 3 in Table 2 shows how those who retired (broad definition) from the HRS sample during the years we observe them differed from the full HRS sample. Retirees were more likely to have an offer of RHBs, positive pension balances, and job tenure exceeding 25 years at wave 1. Further descriptive tabulations based on the first wave of the sample offer preliminary insight into the possible role of RHBs as part of a delayed payment contract. Table 3 shows the mean years of job tenure for workers at the beginning of the panel (1992) by age and whether they were offered RHBs at that time. Two findings seem relevant. First, the age-tenure profile for RHB-offered workers rises and plateaus at age 57, whereas the age-tenure profile for workers not offered RHBs doesn't peak until ages 61–62. This is consistent with RHB-offered workers retiring earlier. Second, workers in their early 50s with RHB offers have substantially more job tenure than those without RHB offers, which suggests the RHB-offered workers may be working under a delayed payment contract.

6. Empirical Findings

Table 4 displays results derived from estimating equation (1) in which the relationship between RHBs and retirement is restricted to be the same for all workers in the HRS sample described above—that is, $\mathbf{x}_{it}\beta$ is specified as in equation (2). In panels 1, 3, and 4, the dependent

variable is transition to broad-definition retirement; in panel 2 narrow-definition retirement is used. To check the sensitivity of the estimates to inclusion of self-employed workers, the panel 3 estimates use a sample from which workers who were self-employed at wave 1 have been dropped. To check the sensitivity of the estimates to inclusion of workers older than 64, the panel 4 estimates use a sample from which workers are dropped when they reach age 65.

Each *dy*/*dx* in Table 4 is the estimated average change in the two-year retirement probability associated with the specified characteristic, based on coefficients estimated by random-effects probit. The *dy*/*dx* of main interest pertains to "employer-provided and RHB." In all four cases, the point estimate is close to 0.03 (with *p*-value = 0.01 or less), which suggests that workers with RHB offers were about 3 percentage points more likely to retire over a two-year period than otherwise similar workers who had EPHI but no RHB offer (the reference group). The mean two-year retirement probability for these workers was 11 percent, so the estimated increase in retirement probability (3 percentage points) implies that RHB-offered workers were more likely to retire than those without by about 27 percent. This is similar to estimates obtained by Rogowski and Karoly (2000) and Blau and Gilleskie (2001), who used early waves of the HRS.

The proposed test of whether RHBs are part of a delayed payment contract amounts to testing whether and how the relationship between RHBs and retirement varies with age. To address these questions, we turn to the unrestricted specification of equation (1). Table 5 displays selected subgroup estimates from applying random-effects probit to equation (1), with $\mathbf{x}_{it}\beta$ specified as in equation (3).[16] For each subgroup, figures in the *dy*/*dx* column give the estimated

[16] Because comparison of panels 1, 3, and 4 in Table 4 show that the estimates are not sensitive to dropping self-employed workers or those older than 64, the estimates in Table 5 are based on the full sample only.

average difference between the retirement probability of workers with an RHB offer and the retirement probability *of workers in the same subgroup that had EPHI but no RHBs*.[17]

To begin, we note that a chi-square tests for equality of the relationship between RHBs and retirement for various subgroups (not displayed) rejects equality in three cases: among age groups, among job tenure categories, and across two-year transitions.

The main findings in Table 5 pertain to the relationship between RHB offers and retirement probabilities at different ages. Under the broad definition of retirement (panel 1), the estimates suggest that workers aged 50–51 with RHB offers are less likely to retire by about 8.7 percentage points, compared with workers aged 50–51 without RHB offers. The point estimates for workers aged 52 and 53 are also negative, but they are smaller and imprecise. At age 54, the estimates suggest that workers with RHB offers are about 4 percentage points more likely to retire than those without. Although the relationship is only marginally significant (p-value = 0.11), the two-year transition for workers aged 54 brackets the fifty-fifth birthday, which is when many workers first become eligible to receive RHBs, so the estimate seems reasonable. From ages 55 to 59, the point estimates are positive but generally small and statistically insignificant. At ages 60 and 61, however, the relationship between an RHB offer and retirement is clearly positive and statistically significant: For these workers, an RHB offer is associated with an increase in retirement probability of 5.8 to 7.0 percentage points. For workers aged 62–64, there again appears to be no significant relationship between RHB offers and retirement.[18]

[17] Section IV describes computation of the subgroup estimates. Subgroup estimates for pension wealth, housing wealth, and non-housing wealth subgroups are statistically insignificant at conventional levels, so we do not report them.

[18] Under the narrow definition of retirement, the point estimates are similar in sign, but usually smaller in absolute value. The negative point estimates for workers in their early 50s are not significant, and the point estimates for workers at ages 60 and 61, although statistically significant, are less than 0.02. Under narrow-definition retirement, the largest positive estimates occur for workers at ages 53 and 55, consistent with workers gaining RHB-eligibility at age 55.

We interpret these estimates as generally consistent with RHBs being part of a Lazear-type delayed payment contract, as described in section 2. Most workers in firms offering RHBs are not eligible to receive RHBs until they reach age 55, so it stands to reason that workers in their early 50s in firms offering RHBs would avoid retirement. This is what we observe. Further, as Table 1 shows, RHB offers often become effective at ages 55 and 60, so the finding that the relationship between RHB offers and retirement probabilities is positive at or about these ages again stands to reason.

The estimates also suggest that the relationship between retirement and RHBs is stronger for workers with long job tenure (more than 15 years) than those with short job tenure (15 or fewer years).[19] This again seems consistent with Table 1, which shows that workers need substantial tenure before they are eligible to receive RHBs. The finding is also consistent with the idea that RHBs are part of a delayed payment contract.

Finally, the estimates in Table 5 suggest that workers with RHB offers were more likely to retire during the 2000–2002 transition than during other periods. During 2000–2002 the labor market was slack,[20] and a stronger relationship between RHBs and retirement during a recession would be consistent with Coile and Levine's (2007) evidence that retirements tend to increase during economic downturns for workers who are eligible for Social Security.[21]

[19] The estimate for < 1 year of tenure is also positive, which would be consistent with RHB-offering employers being more selective and weeding out less productive workers during a probationary period.
[20] During 2000–2002, payroll employment fell by about 1 percent, and the unemployment rate increased from 4.0 to 5.8 percent.
[21] The estimate for the 1994–1996 transition is also positive and statistically significant, and the labor market was robust during that period, so the same explanation does not hold. Although the finding only shows up when the broad definition of retirement is used, it is a puzzling estimate.

7. Implications for Retirement Patterns

To fully interpret the above estimates, we simulate survivor functions based on them—see Table 6 and Figure 3. Each simulation starts with 1,000 full-time workers at age 50 with a given set of characteristics.[22] We calculate the conditional probability (or hazard) of retirement at each age, and apply the retirement hazard for age *t* to the workers still working full time at that age (the risk set). The resulting survivor function shows the number of men who remain working full time at each age.

For each set of estimates, we simulate two survivor functions—one for a cohort without RHB offers (the "No RHBs" columns), and a second for a cohort with them (the "RHBs" columns). The number of retirements associated with RHB offers at age *t* (R_t) is obtained as the difference between the number of retirements of RHB-offered workers at age *t* and the number of retirements of not-RHB-offered workers at the same age.

The survivor functions in panels 1 and 3 of Table 6 restrict the relationship between RHBs and the probability of retirement to be the same at all ages—that is, RHB-offered workers are about 3 percentage points more likely to retire at *any* age. Accordingly, in these simulations, the number of workers surviving at each age in the "RHB" columns is necessarily less than in the "No RHB" columns.[23] The plots on the left of Figure 3 illustrate this for the simulations in panel 1 of Table 6 (which uses the broad definition of retirement).

[22] Specifically, we simulate the survivor function for a worker with the modal characteristic within each set of indicators: DB pension wealth, DC pension accumulation, housing wealth, and non-housing wealth all between $1 and $100,000; white; high school education; BMI between 25 and 30 (overweight); fewer than two chronic health conditions; in good or better self-reported health; married to a spouse who works full time; has more than 25 years of job tenure; is not self-employed; and is not blue collar.

[23] Note that the number of retirements associated with RHBs becomes negative at age 63 for the restricted estimates in panel 1 because by age 63 the risk set for the RHB-offered cohort becomes small enough that it generates fewer retirements than the "No RHB" cohort, even though the RHB-offered cohort has the higher retirement hazard.

In contrast, the survivor functions based on the unrestricted estimates (panels 2 and 4) allow the relationship between RHBs and retirement to vary with age. As a result, the RHB-offered cohorts are larger than the "No-RHB" cohorts when men are in their early 50s, and become smaller only at age 58 (under the broad definition of retirement) or age 55 (under the narrow definition). The plots on the right of Figure 3 illustrate this for the simulations in panel 2 of Table 6 (using broad definition retirement), Here, the RHB-offered workers' survivor function is tilted relative to that of the "No RHB" workers, so the age distribution of a cohort of RHB-offered employees differs from that of workers not offered RHBs. With RHBs, more workers employed in their early 50s (when likely more productive) and substantially fewer employed in their 60s (when they may be less so). The pattern reflects the implicit contractual nature of RHBs and the incentive they give workers to stay with an employer long enough to complete the delayed payment contract, but not longer.

8. Summary and Conclusions

We have used data from the main cohort of the HRS to test the hypothesis that RHBs are part of a delayed payment contract offered by employers who want to attract and retain productive workers over the long term. This "agency" motive for offering RHBs is suggested by Lazear's (1979, 1981) model, which shows that offering a delayed payment contract creates incentives that reduce employee malfeasance and increase productivity. Our empirical approach extends past work on RHBs by specifying an unrestricted model that allows the effect of RHBs to differ among different subgroups of workers—in particular, among workers of different ages. The findings suggest that, at ages 50 and 51, workers in firms offering RHBs are about 8.5 percentage points *less* likely to retire than workers in firms not offering RHBs. This is consistent

with RHB-offered workers acting on a delayed payment incentive to remain with the firm until they become eligible to receive RHBs. In contrast, RHB-offered workers in their mid 50s and at ages 60 and 61 are *more* likely to retire than their counterparts who are not offered RHBs. This is consistent with RHB-offered workers terminating their delayed payment contract at the time specified by the employer via the timing of eligibility for RHBs. Overall, the retirement pattern of men who were offered RHBs in this sample appears consistent with RHBs acting as part of the Lazear-type delayed payment contract.

The empirical survivor functions reported in section 7 clarify the implications of these findings and highlight the importance of allowing the relationship between the probability of retirement and RHBs to vary by age. Survivor functions based on restricted estimates, which force that relationship to be equal for all workers aged 50–65 (and which we reject), suggest that a cohort of RHB-offered workers will shrink monotonically starting at age 50 relative to a cohort of workers who are not offered RHBs. In contrast, survivor functions based on unrestricted estimates, in which the relationship between RHB offers and retirement can vary with age, suggest that a cohort of RHB-offered workers will be larger than a cohort not offered RHBs until workers are in their mid to late 50s. This occurs because workers in firms offering RHBs have an incentive to stay with the firm through the end of the delayed payment contract, which implies not retiring until (typically) age 55 or 60. The findings, then, suggest the importance of understanding firms' motives for offering RHBs in the first place—to reduce malfeasance and increase productivity by offering a long-term contract that reduces worker turnover until a specific age.

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Table 1
Eligibility Requirements for Early Retiree Health Benefits, Employers with 1,000 or More Employees, 1996 and 2003
(percentage of employers)

Requirements	1996	2003
Age 50 + 10 years of service	1%	3%
Age 50 + 15 years of service	1	1
Age 55 + 5 years of service	9	8
Age 55 + 10 years of service	30	38
Age 55 + 15 years of service	5	8
Age 55 + 20 years of service	0	2
Age 60 + 10 years of service	0	2
Based on age/service points	1	9
Based on age and/or service plus age/service points	6	2
Two or more alternatives	35	18
Other (e.g., age only or service only)	11	10
Column sum	100	100

Source: Fronstin (2005), based on data from Hewitt Associates.

Table 2
Sample Descriptive Statistics
(Percentages except number of men and transitions)

	Full sample: all two-year transitions	Full sample: wave 1 values	Retirees (broad definition): wave 1 values
	(1)	(2)	(3)
Number of men	3,150	3,150	2,057
Number of two-year transitions	9,657	n/a	n/a
Health insurance coverage			
employer-provided but no RHBs (reference)	30.8	24.2	22.7
employer-provided and RHBs	51.6	56.1	59.4
non-employer	8.3	7.8	7.2
none	9.4	11.9	10.7
Defined Benefit pension wealth ($)			
0 (reference)	58.8	57.6	54.7
1–100,000	23.0	23.9	24.6
100,001–200,000	8.9	9.2	10.2
> 200,000	9.3	9.2	10.5
Defined Contribution pension accumulation ($)			
0 (reference)	64.7	64.7	62.6
1–100,000	28.0	29.7	31.4
100,001–200,000	3.5	3.2	3.5
> 200,000	3.8	2.4	2.5
Housing wealth ($)			
< 1 (reference)	15.8	18.3	15.8
1–100,000	59.5	62.2	64.9
100,001–200,000	18.0	14.9	15.1
> 200,000	6.7	4.6	4.3
Non-housing wealth ($)			
< 1 (reference)	5.1	5.8	4.8
1–100,000	54.9	61.6	62.1
100,001–200,000	14.9	13.4	13.9
> 200,000	25.1	19.2	19.2
Age			
50–51	4.6	14.1	11.3
52	4.3	10.0	8.6
53	6.9	11.5	10.3
54	6.7	9.6	8.7
55	8.2	9.4	9.8
56	8.3	9.1	9.5
57	9.4	9.6	10.3
58	9.4	7.7	8.8
59	9.2	6.7	7.8
60	9.4	7.7	9.2
61	8.3	4.5	5.5
62	4.9	0.3	0.2
63	3.7	n/a	n/a
64	2.7	n/a	n/a
65	1.6	n/a	n/a
66 or older	2.4	n/a	n/a

Nonwhite	14.6	16.2	14.4
Education			
less than high school (reference)	22.5	24.4	24.2
high school only	32.5	32.7	33.3
some college	19.5	19.2	19.2
college degree or more	25.6	23.6	23.4
Body Mass Index			
underweight (BMI < 18.5)	0.2	0.2	0.3
normal (18.5 ≤ BMI < 25) (reference)	27.1	29.6	27.7
overweight (25 ≤ BMI < 30)	49.6	49.5	50.4
obese (BMI ≥ 30)	23.1	20.7	21.6
Multiple chronic health conditions	26.8	20.1	21.5
Fair or poor self-reported health	12.2	11.9	12.2
Marital status and spouse's employment			
not married (reference)	15.2	15.9	15.0
married/spouse full-time	37.1	37.9	37.9
married/spouse part-time	14.2	14.9	15.7
married/spouse < part-time	33.5	31.2	31.4
Job tenure			
< 1 year (reference)	6.1	7.7	7.3
1–5 years	15.7	17.2	15.3
5–10 years	15.8	14.6	15.4
10–15 years	12.4	11.4	10.8
15–25 years	20.7	21.7	21.0
> 25 years	29.4	27.4	30.2
Self-employed	20.1	19.6	17.4
Blue-collar occupation	43.1	44.4	44.6
Transitions			
1992–1994 (reference)	32.6	100	100
1994–1996	24.0	0	0
1996–1998	17.3	0	0
1998–2000	12.4	0	0
2000–2002	8.5	0	0
2002–2004	5.3	0	0

Source: Health and Retirement Study sample of 3,150 men aged 51 to 61 who were working full-time in 1992.

Note: Broad-definition retirement (column 3) is movement from full-time/full-year employment to either self-reported retirement or the "other" category (employed part-time, unemployed, disabled, not in the labor force) in Figure 2.

Table 3
Mean Job Tenure (in Years) at Wave 1, by Age and Whether Employer Offered RHBs

Age	RHBs offered	RHBs not offered	N
50–51	15.6	12.0	443
52	16.2	11.1	314
53	17.7	10.9	361
54	17.6	11.6	302
55	18.3	12.9	296
56	18.1	14.4	286
57	20.0	15.8	302
58	20.3	14.6	243
59	17.4	16.2	211
60	20.3	16.1	243
61	18.0	17.0	141
62	13.6	17.1	8
all ages	17.9	13.4	3150

Source: Authors' tabulations of the Health and Retirement Survey, 1992 (wave 1) sample. See Table 2 notes for details.

Table 4
Estimates of the Restricted Model

	(1)			(2)			(3)			(4)		
Dependent variable:	Left FT employment for broad-definition retirement			Left FT employment for narrow-definition retirement			Left FT employment for broad-definition retirement			Left FT employment for broad-definition retirement		
Sample:	Full			Full			Drop workers self-employed in wave 1			Drop observations at age 65		
Independent variable	*dy/dx*	s.e.	*p*-value	*dy/dx*	s.e.	*p*-value	*dy/dx*	s.e.	*p*-value	*dy/dx*	s.e.	*p*-value
Health Insurance coverage												
employer-provided but no RHBs (reference)	—	—	—	—	—	—	—	—	—	—	—	—
employer-provided and RHBs	0.032	0.010	0.001	0.027	0.006	0.000	0.027	0.011	0.012	0.034	0.010	0.001
non-employer	0.035	0.018	0.056	0.030	0.014	0.032	0.049	0.026	0.064	0.039	0.020	0.051
none	0.042	0.018	0.022	-0.002	0.012	0.899	0.047	0.024	0.050	0.041	0.018	0.026
Defined Benefit pension wealth ($)												
0 (reference)	—	—	—	—	—	—	—	—	—	—	—	—
1–100,000	0.010	0.012	0.386	0.018	0.008	0.020	0.012	0.012	0.341	0.008	0.012	0.484
100,001–200,000	0.083	0.019	0.000	0.071	0.014	0.000	0.075	0.020	0.000	0.082	0.019	0.000
> 200,000	0.079	0.019	0.000	0.079	0.015	0.000	0.070	0.020	0.001	0.075	0.019	0.000
Defined Contribution pension accumulation ($)												
0 (reference)	—	—	—	—	—	—	—	—	—	—	—	—
1–100,000	-0.034	0.010	0.000	-0.017	0.006	0.003	-0.038	0.010	0.000	-0.035	0.010	0.000
100,001–200,000	0.004	0.023	0.860	-0.001	0.013	0.916	-0.016	0.023	0.500	0.004	0.023	0.853
> 200,000	0.032	0.023	0.169	0.002	0.014	0.895	0.017	0.026	0.517	0.035	0.024	0.142
Housing wealth ($)												
< 1 (reference)	—	—	—	—	—	—	—	—	—	—	—	—
1–100,000	0.007	0.013	0.560	0.005	0.008	0.519	0.004	0.014	0.773	0.009	0.013	0.482
100,001–200,000	0.012	0.016	0.441	0.008	0.011	0.475	0.018	0.018	0.317	0.018	0.016	0.275
> 200,000	-0.003	0.021	0.886	0.003	0.014	0.808	0.033	0.028	0.227	0.000	0.021	0.996
Non-housing wealth ($)												
< 1 (reference)	—	—	—	—	—	—	—	—	—	—	—	—

1–100,000	0.010	0.020	0.599	0.032	0.014	0.022	0.008	0.021	0.725	0.008	0.020	0.693
100,001–200,000	0.055	0.025	0.026	0.070	0.023	0.002	0.062	0.027	0.023	0.054	0.025	0.031
> 200,000	0.048	0.024	0.043	0.071	0.021	0.001	0.046	0.027	0.084	0.042	0.024	0.076
Age												
50–51	—	—	—	—	—	—	—	—	—	—	—	—
52	0.025	0.035	0.467	0.071	0.042	0.090	0.009	0.039	0.822	0.023	0.034	0.490
53	0.075	0.034	0.027	0.074	0.039	0.057	0.092	0.039	0.019	0.074	0.033	0.028
54	0.058	0.034	0.081	0.052	0.036	0.146	0.062	0.039	0.106	0.057	0.033	0.084
55	0.073	0.033	0.028	0.083	0.039	0.033	0.102	0.039	0.009	0.072	0.033	0.027
56	0.030	0.031	0.335	0.052	0.034	0.132	0.044	0.036	0.229	0.029	0.031	0.341
57	0.095	0.034	0.005	0.130	0.044	0.003	0.126	0.040	0.002	0.093	0.033	0.005
58	0.101	0.034	0.003	0.114	0.042	0.006	0.115	0.039	0.003	0.098	0.033	0.003
59	0.169	0.036	0.000	0.193	0.050	0.000	0.183	0.042	0.000	0.165	0.036	0.000
60	0.312	0.038	0.000	0.347	0.058	0.000	0.360	0.043	0.000	0.307	0.038	0.000
61	0.359	0.039	0.000	0.376	0.060	0.000	0.411	0.043	0.000	0.356	0.039	0.000
62	0.325	0.043	0.000	0.343	0.064	0.000	0.375	0.049	0.000	0.321	0.043	0.000
63	0.397	0.045	0.000	0.401	0.068	0.000	0.450	0.049	0.000	0.395	0.045	0.000
64	0.417	0.048	0.000	0.429	0.071	0.000	0.471	0.052	0.000	0.415	0.048	0.000
65	0.399	0.055	0.000	0.350	0.079	0.000	0.446	0.063	0.000	n/a	n/a	n/a
66 or older	0.369	0.053	0.000	0.349	0.075	0.000	0.376	0.061	0.000	n/a	n/a	n/a
Nonwhite	-0.005	0.012	0.694	-0.011	0.007	0.119	-0.019	0.013	0.127	-0.003	0.012	0.793
Education												
less than high school (reference)	—	—	—	—	—	—	—	—	—	—	—	—
high school only	-0.009	0.012	0.464	-0.007	0.007	0.340	-0.013	0.013	0.333	-0.007	0.012	0.577
some college	-0.009	0.014	0.515	-0.023	0.008	0.002	-0.005	0.016	0.729	-0.006	0.014	0.677
college degree or more	-0.038	0.014	0.007	-0.036	0.008	0.000	-0.046	0.016	0.004	-0.037	0.014	0.009
Body Mass Index												
underweight (BMI < 18.5)	0.276	0.124	0.026	0.103	0.093	0.268	0.262	0.135	0.051	0.303	0.129	0.019
normal (18.5 ≤ BMI < 25) (reference)	—	—	—	—	—	—	—	—	—	—	—	—
overweight (25 ≤ BMI < 30)	0.007	0.010	0.459	0.006	0.006	0.367	0.011	0.011	0.325	0.002	0.010	0.860
obese (BMI ≥ 30)	0.026	0.012	0.036	0.013	0.008	0.116	0.024	0.014	0.091	0.022	0.012	0.074
Multiple chronic health conditions	0.029	0.010	0.004	0.013	0.006	0.040	0.032	0.011	0.005	0.027	0.010	0.009
Fair or poor self-reported health	0.055	0.014	0.000	0.033	0.010	0.001	0.063	0.016	0.000	0.061	0.014	0.000

Marital status and spouse's employment												
not married (reference)	—	—	—	—	—	—	—	—	—	—	—	—
married/spouse full-time	-0.039	0.013	0.002	-0.029	0.008	0.000	-0.043	0.014	0.002	-0.042	0.013	0.001
married/spouse part-time	-0.051	0.014	0.000	-0.036	0.007	0.000	-0.060	0.015	0.000	-0.054	0.014	0.000
married/spouse < part-time	-0.010	0.013	0.450	-0.012	0.008	0.109	-0.018	0.014	0.219	-0.018	0.013	0.173
Job tenure												
< 1 year (reference)	—	—	—	—	—	—	—	—	—	—	—	—
1–5 years	-0.022	0.019	0.248	-0.002	0.015	0.869	-0.045	0.020	0.022	-0.025	0.019	0.173
5–10 years	-0.048	0.018	0.008	0.006	0.015	0.698	-0.065	0.019	0.001	-0.048	0.018	0.007
10–15 years	-0.040	0.019	0.036	0.019	0.017	0.277	-0.056	0.020	0.005	-0.043	0.019	0.020
15–25 years	-0.026	0.019	0.161	0.043	0.018	0.016	-0.039	0.021	0.057	-0.035	0.018	0.056
> 25 years	-0.019	0.019	0.324	0.047	0.017	0.005	-0.020	0.022	0.359	-0.018	0.019	0.349
Self-employed	-0.044	0.012	0.000	-0.059	0.006	0.000	-0.078	0.024	0.001	-0.044	0.012	0.000
Blue-collar occupation	0.014	0.010	0.156	0.012	0.006	0.049	0.013	0.011	0.239	0.015	0.010	0.127
Transitions												
1992–1994 (reference)	—	—	—	—	—	—	—	—	—	—	—	—
1994–1996	-0.008	0.012	0.495	-0.001	0.008	0.887	-0.002	0.013	0.887	-0.008	0.012	0.504
1996–1998	-0.029	0.013	0.022	-0.007	0.008	0.388	-0.027	0.015	0.063	-0.031	0.013	0.015
1998–2000	-0.037	0.014	0.008	-0.007	0.009	0.434	-0.037	0.016	0.018	-0.034	0.014	0.013
2000–2002	-0.027	0.016	0.091	0.005	0.011	0.626	-0.015	0.019	0.412	-0.020	0.017	0.235
2002–2004	-0.050	0.018	0.006	-0.014	0.011	0.204	-0.041	0.021	0.052	-0.057	0.019	0.002
Sample size (person-wave observations)		9,657			9,657			7,729			9,274	
Number of individuals		3,150			3,150			2,532			3,150	

Notes: Estimates come from applying a random effects probit estimator to equation (1), with covariates specified as in equation (2). The dependent variable is an indicator equal to 1 if a man moved from full-time/full-year employment in period *t* to broad-definition retirement (columns 1, 3, and 4) or to narrow-definition retirement (column 2) in period *t*+1 (approximately two years after *t*). Broad-definition retirement is the union of self-reported retirement and the "other" category in Figure 2. Narrow-definition retirement is self-reported retirement only. The full sample is the sample described in Table 2 and Figure 2. Figures in the "*dy*/*dx*" column give the estimated average change in the two-year retirement probability associated with each specified characteristic, based on the probit estimates. Standard errors are robust to heteroskedasticity and serial correlation of errors for each worker over time.

Table 5
Estimated Changes in Conditional Retirement Probabilities Associated with Subgroup Characteristics, Based on the Unrestricted Model

Dependent variable:	(1) Left FT employment for broad-definition retirement		(2) Left FT employment for narrow-definition retirement	
Subgroup or transition	*dy/dx*	*p*-value	*dy/dx*	*p*-value
Age				
50–51	-0.087	0.012	-0.021	0.358
52	-0.033	0.324	-0.027	0.117
53	-0.030	0.223	0.035	0.027
54	0.041	0.106	0.019	0.217
55	0.007	0.772	0.027	0.037
56	0.014	0.562	0.010	0.454
57	0.017	0.405	0.008	0.439
58	0.030	0.140	0.018	0.080
59	0.019	0.309	0.013	0.154
60	0.070	0.000	0.019	0.011
61	0.058	0.002	0.016	0.037
62	0.019	0.432	0.004	0.702
63	0.009	0.756	0.025	0.042
64	0.024	0.460	-0.011	0.428
Job tenure				
< 1 year	0.064	0.008	0.025	0.067
1–5 years	-0.022	0.176	-0.009	0.292
5–10 years	-0.005	0.769	0.003	0.718
10–15 years	-0.005	0.776	0.009	0.296
15–25 years	0.025	0.066	0.018	0.005
> 25 years	0.035	0.003	0.018	0.001
Transitions				
1992–1994	-0.001	0.952	0.011	0.097
1994–1996	0.031	0.019	0.006	0.343
1996–1998	-0.002	0.901	0.011	0.114
1998–2000	0.012	0.475	0.004	0.577
2000–2002	0.048	0.017	0.026	0.003
2002–2004	0.039	0.137	0.015	0.203

Notes: See the notes to Table 4. For each subgroup, *dy*/*dx* is the estimated average difference between the two-year retirement probability of workers with an offer of RHBs and the retirement probability of workers in the same subgroup who had EPHI but no RHB offer. Subgroup estimates are obtained by estimating equation (1) with covariates specified as in equation (3)—i.e., with *rhb* fully interacted with the other independent variables in the model. Each subgroup estimate is computed by evaluating the derivative of *retired* with respect to *rhb* for the subgroup at the sample mean. (See section VI for details.) Complete model estimates are available from the authors.

Table 6
Survivor Functions for Men Aged 50 to 65 and RHB-associated Retirements (R_t) at Each Age

	Dependent variable: Left FT employment for broad-definition retirement						Dependent variable: Left FT employment for narrow-definition retirement					
	(1) Restricted			(2) Unrestricted			(3) Restricted			(4) Unrestricted		
Age	No RHBs	RHBs	R_t	No RHBs	RHBs	R_t	No RHBs	RHBs	R_t	No RHBs	RHBs	R_t
50	1000	1000	6	1000	1000	-18	1000	1000	4	1000	1000	-5
51	978	972	6	966	984	-17	994	990	4	990	995	-5
52	956	944	6	932	967	-3	987	979	8	980	990	-14
53	930	912	7	902	940	-3	971	955	8	953	977	17
54	896	870	6	864	905	20	954	930	7	945	953	8
55	866	834	6	841	862	9	941	911	8	936	935	14
56	834	796	5	812	824	8	924	885	6	926	911	4
57	811	768	6	791	795	12	911	866	10	915	896	6
58	777	729	5	761	753	15	885	830	8	891	866	11
59	744	690	5	734	710	13	863	800	11	875	839	12
60	699	640	5	693	656	42	826	751	14	843	795	26
61	624	560	3	638	560	28	750	661	11	781	707	18
62	546	479	1	574	468	3	674	574	7	715	623	-2
63	486	418	-1	516	407	-5	617	510	4	657	567	21
64	419	352	-3	447	342	-1	552	442	1	606	494	-23
65	357	293	--	388	284	--	490	378	--	532	444	--

Note: The "No RHBs" and "RHB" columns show the number of workers without and with RHB offers who remain working full-time based on conditional retirement probabilities calculated from the estimates in Tables 4 (panels 1 and 2) and 5 and applied to a cohort of 1,000 workers starting at age 50. (The survivor figures are rounded to the nearest whole number.) The R_t column shows the number of RHB-associated retirements at each age (negative when RHB-offered workers have more retirements than those not offered RHBs).

Figure 1
Delayed Payment Contracts and the Timing of Retirement in Lazear's Agency Model

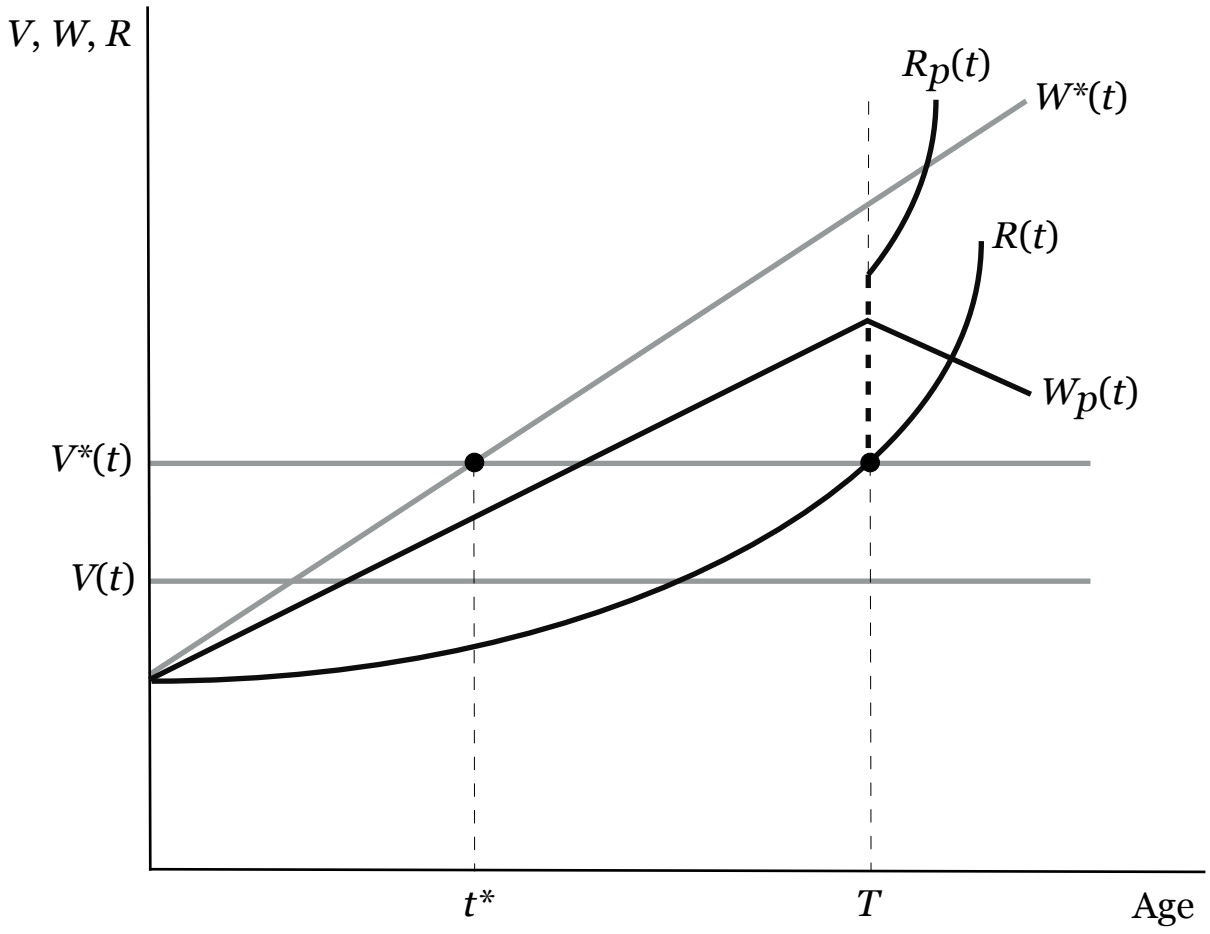
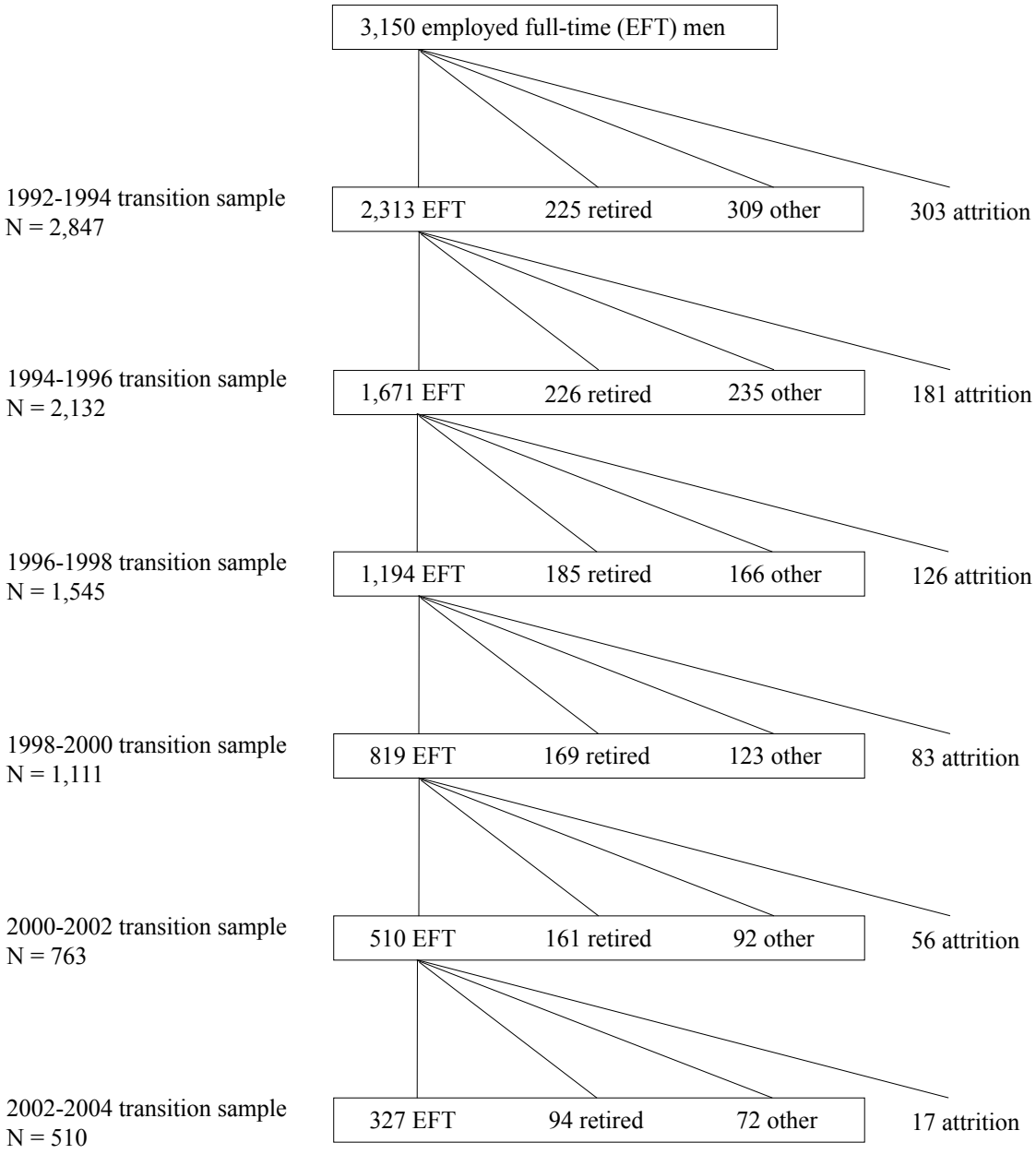
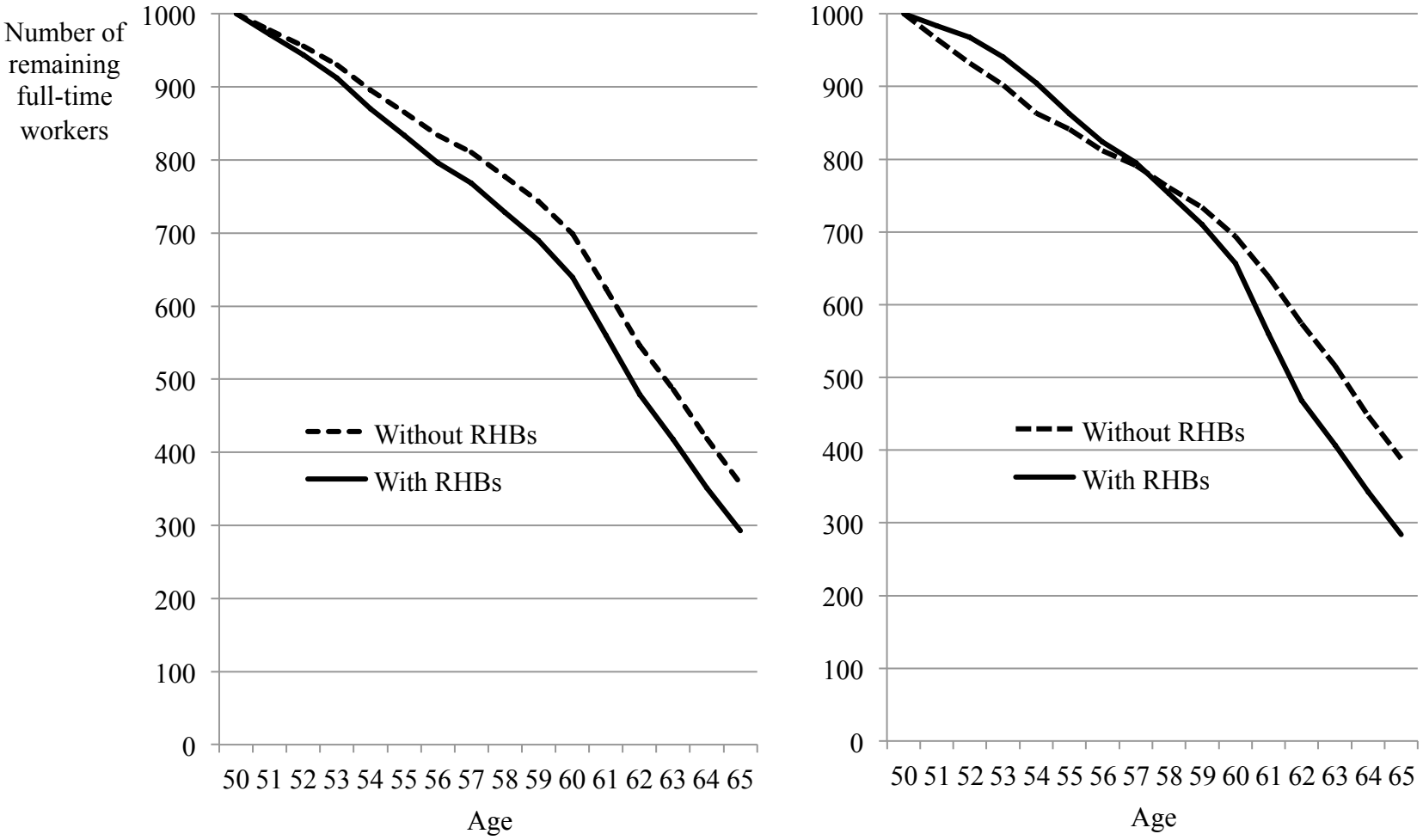


Figure 2
HRS Analysis Sample Transitions Illustrated



Notes: "EFT" are employed full-time workers. "Retired" in this figure refers self-reported retired workers. "Other" refers to men no longer EFT, but not self-reported retired. (The group includes those employed part-time, unemployed, disabled, and not in the labor force.) "Attrition" refers to those not interviewed in the following wave, for any reason.
Source: Authors' tabulations of Health and Retirement Study data. See text for discussion.

Figure 3
Survivor Functions for Full-Time Workers With and Without RHB Offers, Based on the Restricted Model (left) and the Unrestricted Model (right)



Source: Table 6, panels 1 and 2.